

Land-Use Changes and Heart Disease Risk: Evidence That Rapid Development Plays a Role

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Hyderabad, a city in the South Indian state of Telangana, is known for its iconic bazaars and 16th century architecture¹ as well as a booming tech industry that is fueling massive growth.² Undeveloped landscapes and farmland in the area are being rapidly lost to development, and the city's traffic congestion ranks among the worst in India.³ Now a recent study in *Environmental Health Perspectives* reports that heart disease risk among Hyderabad's local population is increasing as the pace of land-use changes accelerates.⁴

Cathryn Tonne, an environmental epidemiologist at the Barcelona Institute for Global Health, is the study's senior author. She says higher levels of air pollution and reduced physical activity resulting from land-use changes in and around Hyderabad may contribute to the findings, which she describes as “remarkably consistent.”

Several years ago, Tonne and her colleagues launched a project called Cardiovascular Health Effects of Air Pollution in Telangana, India (CHAI), to measure combustion air pollutants in households and quantify the corresponding relationships between exposure and cardiovascular disease end points. For this

latest investigation, she and her colleagues focused specifically on whether air pollution, physical activity, and stress mediate cardiovascular risk under a range of changing land-use trajectories.

The investigators used heart health data gathered by the Andhra Pradesh Children and Parent Study (APCAPS). This ongoing effort by Indian and British scientists tracks cardiovascular outcomes among children born in 28 villages south of Hyderabad between 1987 and 1990, as well as their parents and siblings.⁵ The authors estimated air quality at the homes of the study participants using a previously developed air pollution model of fine particulate matter (PM_{2.5}). This model was based on measurements collected by CHAI researchers at 23 sites within the APCAPS study area.

The team estimated land-use changes between 1995 and 2009 by training machine-learning algorithms to characterize land-use patterns within remote sensing data. They divided the changes over that period into three trajectories: a stable trajectory of minimal change, a slow trajectory for gradual replacement of green spaces and farmland by human-constructed elements, and a fast trajectory during which replacement happened rapidly. Most of



The outskirts of Hyderabad are mostly farm fields and large expanses of undeveloped lands. But much of this landscape is being rapidly built up as the city becomes a leader in the Indian tech industry. Image: © Achintya Dixit/Shutterstock.

the rapidly changing areas were located close to the Nehru Outer Ring Road, a highway surrounding the urban core.

Finally, Tonne's team connected the dots by looking at the interplay of land-use changes in 1995–2009 and six cardiometabolic measures in 2010–2012: systolic blood pressure (SBP), diastolic blood pressure (DBP), waist circumference, and blood concentrations of triglycerides, fasting glucose, and non-high-density lipoprotein (non-HDL) cholesterol. Clustered together, higher-than-normal values for these measures define metabolic syndrome, which can lead to heart disease, stroke, and type 2 diabetes.⁶

Their analysis showed that participants with the worst heart health—as indicated by elevated SBP, DBP, waist circumference, and fasting glucose—tended to live in households within 300 m of areas where land-use changes were occurring rapidly. These same areas were associated with lower physical activity among residents and higher pollution levels. The associations with triglycerides and non-HDL in the fast-changing areas were also positive but less precise. Compared with participants living near areas with stable trajectories, the associations with all six risk factors were stronger for individuals living near areas with fast trajectories. Associations were stronger in women than in men, possibly because women in this region tend to spend more time at home than men.⁷

Tonne says most of the evidence connecting cardiovascular health with surrounding green space comes from studies in the United States and Europe,⁸ whereas comparable evidence from low- and middle-income countries is lacking. The results from her study, she says, show evidence of the pattern in a developing world setting—“Not all the associations are statistically significant, but they're going in the direction we expected.” Notably, however, it is difficult to disentangle the potential health effects of rapid industrialization, which may entail changes in socioeconomic status, food choices, and other factors involved in metabolic status.

Kevin Lane, an assistant professor of environmental health at Boston University, applauds Tonne's focus on land-use changes

over time. “That's what is particularly novel and innovative about this paper,” says Lane, who was not involved in the study. “It provides helpful information for urban planners. You can show them that faster development has stronger impacts on cardiovascular outcomes than longer, drawn-out change. And that's important for them to know.”

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